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Studies on the flora of northern South America—X[1]

H. A. Gleason

MISCELLANEOUS NEW OR NOTEWORTHY SPECIES

Dichaea graminoides (Sw.) Lindl. The history of this species extends back to 1788, when Olof Swartz published a twelve-word description of *Epidendrum graminoides* from Jamaica. The description offers nothing by which we may accurately distinguish the species today, but his citation of the locality is important. In 1799 he transferred his species to the genus *Cymbidium*. Maintaining it in this genus in his *Flora Indiae Occidentalis* in 1806, he then specified its range more exactly, as on trees in the temperate region of the mountains of southern Jamaica. His posthumous *Adnotationes Botanicae* provided a crude illustration of it in 1829. Under one or the other of these two genera the species appears in a few contemporary publications. It was transferred to the genus *Isochilus* by Hooker in 1827, retaining the original specific name. Sprengel referred it erroneously in 1826 to *Isochilus graminifolius* HBK., spelling the name *Isochilos*. Cogniaux (*Fl. Bras.* **3**[6]: 493) quotes this name as *Isochilon*, a practice followed in 1923 by Kränzlin (*Pflanzenreich* **83**: 47), who apparently drew heavily on Cogniaux for both inspiration and facts. Lindley placed it in the genus *Dichaea* in 1833, retaining Swartz' specific name and thereby settling its nomenclatural troubles, so far as we can foresee at present, although Grisebach (*Fl. Brit. W. Ind.* 625) saw fit to change its name to *graminea*. Fawcett & Rendle (*Fl. Jamaica* **1**: 138. *pl. 30, f. 8–12*) gave an excellent illustration, and noted that they have 'not seen any specimens elsewhere than from Jamaica that appear to agree with the description of the species.' They also had the advantage of examining original material collected by Swartz himself.

It has nevertheless been confused by various writers with other species from widely scattered localities. Sprengel's transfer of the species in 1826 was the first of these cases, confusing it, through lack of plates or specimens, with a Colombian plant.

[1] Contributions from the New York Botanical Garden, no. 288.

[The Bulletin for October (**54**: 559–602) was issued 7 November 1927]

Hooker made a similar error in 1827: after citing the Swartzian names as synonyms for *Isochilus graminoides*, he pictured a totally different plant sent him from Trinidad. Grisebach included under the species plants from as far south as Guiana. Cogniaux extended its range as far as southern Brazil, Peru, and Colombia, on the basis of various cited specimens. Kränzlin accepted all of these and pushed its limits northwest to Mexico. So far as Swartz or Fawcett and Rendle knew, and so far as our material shows, the species does not extend beyond Jamaica, and every extension of range has erroneously combined other species with it. Cogniaux illustrated an entirely different species, as a moment's comparison of his plate with that of Fawcett and Rendle will show, while Kränzlin carried the matter to the extreme by referring the Jamaica material to another species, *D. brachyphylla* Rchb. f.

There appears to be no doubt that the name *graminoides* properly belongs to the Jamaican species, of which we have abundant material agreeing in every detail with Fawcett and Rendle's illustration. I offer no opinion as to its occurrence in Cuba or other West Indian islands. Schlechter saw this condition in 1921, and gave the name *D. Cogniauxiana* to the Brazilian material described as *graminoides* by Cogniaux in the *Flora Brasiliensis*.

Specimens from British Guiana differ distinctly from *D. Cogniauxiana* in several small but important details. The petals and sepals are obtuse or subacute, shorter, broader, and never more than half as broad as long; the lip is broader than long, with shorter and broader claw, and with retrorsely curved narrow lateral lobes; the leaves shorter and somewhat narrower. It may be described as

Dichaea Rendlei n. sp. Stems several, cespitose, 10–17 cm. high; leaf-sheaths carinate, overlapping, 8 mm. long, with 6 or 7 nerves on each side; leaf-blades linear-oblong, 18–25 mm. long, 2–3 mm. wide, obtuse and minutely apiculate, entire, with 7–9 straight conspicuous nerves on each side of the median, articulate at base; peduncles solitary, filiform, surpassing the leaf-sheath by 4–5 mm.; lower bractlet obliquely ocreate, campanulate, 2.1 mm. long on the dorsal side, 1.2 mm. long below; upper bractlet linear, 1.8 mm. long; dorsal sepal ovate from a broad base, 4.2 mm. long, 2.5 mm. wide, obtuse, 3-nerved, the lateral nerves either ending free or uniting with the mid-nerve; lateral sepals ovate, 5.3 mm. long, 2.6 mm. wide, subacuminate, unsym-

metrical, with 1 lateral nerve on the narrower side and 2 on the broader; lateral petals ovate, unsymmetrical, 4 mm. long, 2.1 mm. wide, obtuse or subacute, 3-nerved, the lateral nerves ending free; labellum 5 mm. long, the claw rapidly dilated, the lamina broadly anchor-shaped, subacute, 5.3 mm. wide, the lateral lobes linear, acute, 1 mm. long, retrorsely curved; ovary and fruit smooth.

Type, *La Cruz 1623*, collected between the Demerara and Berbice Rivers, lat. about 5° 50′ N., British Guiana, 15–19 July, 1922, and deposited in the herbarium of the New York Botanical Garden. Other specimens are *La Cruz 1696* and *2180*.

Dichaea trinitensis n. sp. Plants mostly solitary and simple, rarely once branched, 8–18 cm. tall, glabrous throughout; leaf-sheaths strongly conduplicate, 7 mm. long, with 3 strong nerves near each margin and several weaker intermediates; leaf-blade articulated at base, oblong, 12–17 mm. long, 3–4 mm. wide, acute, strictly entire, sometimes minutely scabrellate toward the apex, with mostly 3 nerves on each side of the median; peduncles solitary in the upper axils, filiform, nearly as long as the leaves; lower bractlet ocreiform, campanulate, apiculate and 2 mm. long above, 0.6 mm. long below; upper bractlet ovate, acuminate, 2 mm. long, 0.8 mm. wide; ovary glabrous; dorsal sepal ovate, 4.7 mm. long, 2 mm. wide, acuminate, 3-nerved, the lateral nerves confluent with the midnerve at about half its length; lateral sepals strongly saccate at base, falcately ovate, acute, 6 mm. long, 2.7 mm. wide, 3-nerved; dorsal petals ovate, slightly unsymmetrical, 4.5 mm. long, 2 mm. wide, 3-nerved, the lateral nerves extending nearly to the apex; labellum 5.3 mm. long, unguiculate below, gradually dilated above for two-thirds of its length, thence abruptly expanded into a triangular lamina 4.2 mm. wide, 7-nerved.

Type, *Broadway* without number, collected on trees, Trinidad, 3 Sept. 1919, and deposited in the herbarium of the New York Botanical Garden. Four other specimens in the same herbarium, *Britton, Coker, & Rowland 1786*, *Britton, Broadway, & Hazen 274*, *Britton, Hazen, & Mendelson 600* and *892*, from which the flowers have all fallen, agree with it in vegetative characters. The species is apparently most closely related to *Dichaea brachyphylla* Rchb. f., of southern Brazil, in which the leaves are ciliate above, the peduncles only 3 mm. long, and the sepals and petals less than 1 mm. wide. Hooker (*Exotic Flora pl. 196*) probably illustrated this plant under the name *Isochilus graminoides* in 1827, confusing it with the Jamaican *Dichaea graminoides* (Sw.) Lindl.

DICHAEA PICTA Rchb. f. Stems densely cespitose, leafy, simple or sparingly branched, 1–2 dm. long; leaf-sheaths conduplicate, 8 mm. long, with 5 principal nerves and a few intermediates on each side; leaf-blades oblong, 12–17 mm. long, 3–4 mm. wide, sharply acute, strictly entire and glabrous, usually wrinkled in drying, the obscure nerves mostly 3 on each side of the median; peduncles solitary in the axils, filiform, two-thirds as long as the subtending leaf; lower bractlet ocreiform, campanulate, acute and nearly 2 mm. long on the dorsal side, half as long below; upper bractlet linear, 2.6 mm. long, 0.4 mm. wide; dorsal sepal ovate, naviculate, 4.2 mm. long, strongly acuminate, the 3 nerves extending nearly to the apex; lateral sepals strongly saccate at base, falcate-ovate, 6.5 mm. long, 2.5 mm. wide, sharply acuminate, 4-nerved, the 3 lateral nerves abruptly inflexed at the apex and confluent with the midnerve (or the fourth with the third lateral nerve); dorsal petals ovate-oblong, 4.8 mm. long, 2 mm. wide, acuminate, slightly unsymmetrical, 5-nerved, the outer ending free, the intermediates confluent with the midnerve; labellum 5.3 mm. long, curved-ascending, the claw 2 mm. long by 1 mm. wide, gradually widened upward and thence abruptly dilated into the broadly ovate 7-nerved lamina, the lateral lobes triangular, barely retrorse.

The type material of this species was collected in Trinidad. Our Guiana specimens, *La Cruz 1504, 1930, 2602, 2814, 4264,* agree with the description in every essential feature and also match nicely with the original plate.

DICHAEA DAMMERIANA Kränzlin. The author of the species unfortunately had no flowers available for dissection. A specimen of the type number in the herbarium of the New York Botanical Garden has a single flower in good condition, and permits me to add the following to the original description (*Pflanzenreich* **83**: 41. 1923).

Outer bractlet surrounding the peduncle but not ocreiform, broadly orbicular, 2.7 mm. long, minutely apiculate; inner bractlet oblong, acute, 3 mm. long, 0.8 mm. wide; ovary densely and softly echinate; dorsal sepal oblong-obovate, broadest at two-thirds of its length, 9.5 mm. long, 3.6 mm. wide, obtuse, 5-nerved, the lateral nerves ending free, densely covered on the distal half with soft papillae; lateral sepals obovate, broadest above the middle, 8 mm. long, 4.6 mm. wide, broadly obtuse, sparsely muricate along the midvein in the distal half, 5-nerved or with a faint additional nerve, the lateral nerves ending free; dorsal petals ovate-oblong, broadest at the middle, 9 mm. long, 3.2 mm. wide, obtuse, prominently but sparsely echinate along the midvein on the basal two-thirds, with a few scattered and shorter papillae along the sides also, slightly unsymmetrical,

with 1 lateral nerve on the narrower and 2 on the broader side; labellum 6.7 mm. long, strongly curved-ascending with erect sides, 7-nerved, the lateral nerves ending free with incurved tips, the claw 0.6 mm. wide at base, gradually widened for 3.5 mm. and thence abruptly dilated into a depressed-triangular, obtuse lamina 6.4 mm. wide and 2.5 mm. long.

Cymbopetalum venosum n. sp. Stem and foliage glabrous; petioles stout, narrowly two-winged, 10–15 mm. long; leaf-blades firm or subcoriaceous, elliptic-oblong, broadest at or near the middle, 15–18 cm. long, 5–6 cm. wide, abruptly subacuminate to a sharp apex, obtuse at base, with a tendency to be decurrent on the petiole, entire, slightly revolute; lateral veins arising at an angle of 80°, curved-ascending, and more or less arcuately connected near the margin, both veins and veinlets elevated on both surfaces and finely and prominently reticulate; fruits somewhat curved, brown-purple, 2–3 cm. long, 3–4-seeded, somewhat constricted between the seeds, on stipes 10–15 mm. long.

Type, *La Cruz 2004*, collected at Bartica, on the Essequibo River, British Guiana, 3–12 Sept., 1922, and deposited in the herbarium of the New York Botanical Garden. Duplicates have been distributed to the principal American herbaria.

In leaf form, *C. venosum* approaches most closely the well-known *C. brasiliense* (Vell.) Benth., in which the leaf-blades are widest distinctly above the middle, long-cuneate to the base, thin and membranous in texture, scarcely reticulate, with lateral veins strongly arcuate-connected near the margin, and on petioles only 2–3 mm. long.

Cryptocarya pachycarpa n. sp. Arborescent; bark of the twigs strongly verrucose with conspicuous lenticels; petioles stout, sharply 2-edged, verrucose, 8–12 mm. long; leaf-blades firm, dull brownish green when pressed, oblanceolate to narrowly obovate or obovate-oblong, 10–14 cm. long by 35–58 mm. wide, abruptly short-acuminate to a blunt or rounded tip, gradually cuneate to the base, glabrous; lateral veins ascending at an angle of 60°, the veinlets obscure and minutely impressed above, prominulous and finely reticulate beneath; inflorescence racemose from the upper axils, 3–6 cm. long; flowers unknown; fruiting pedicels stout, 2–5 mm. long; fruit broadly pyriform, 8–10 mm. in length and diameter, composed of a thick, corky or woody, enlarged perianth-tube crowned with the remnants of the perianth and stamens, almost completely enclosing the drupe within its distal half; drupe hemispherical, 5 mm. in diameter, smooth, tipped with a short style.

Type, *La Cruz 4215*, collected at Kamakusa, on the upper Mazaruni River, British Guiana, 11–22 July 1923, and deposited

in the herbarium of the New York Botanical Garden. Duplicates have been distributed to the principal American herbaria.

While the perianth-tube surrounds the ovary in a few genera of Lauraceae, and embraces a portion of it in fruit in some of them, only the genus *Cryptocarya* ripens the perianth tube into a complete enclosure for the drupe. In all the fruiting specimens examined, the perianth-tube is completely enclosed at maturity, concealing the drupe entirely, and is comparatively thin and uniform from base to apex. In our present species the tube is greatly thickened, especially toward the base, and maintains a small orifice at the apex, through which the short style protrudes. A difference of this sort seems not only important, but even suggestive of generic rank for our plant. In the absence of flowers, it has been retained in the genus *Cryptocarya*.

The floral organs still persist on the summit of most of the fruits to some extent. It is clear from their remains, or from the scars left after their fall, that there are three sepals, three petals, and at least nine stamens. The sepals and petals are much alike in size and shape, and appear to be ovate. In one or two instances it is still evident that the anthers are 2-locellate. No trace of a fourth series of stamens or staminodes is visible.

Lecostemon sylvestre n. sp. A small tree, 5 m. high; upper portion of the stem strongly angled, slightly scabrellate, dark reddish brown; leaf-blades thin but firm, dull green, oblanceolate, the largest 32 cm. long by 8 cm. wide, broadest at two-thirds of their length, gradually rounded into an acuminate tip, gradually tapering with straight sides from above the middle to the base, entire, glabrous on both sides, minutely punctate beneath with reddish glands, the midvein prominent beneath, the lateral veins strongly ascending and outwardly arcuate; petioles prominently striate, ferruginous-scabrellate, 25–35 mm. long; racemes supra-axillary, 13 cm. long, bearing 6–8 flowers on the distal half, the rhachis flattened, prominently striate, fulvous-scabrellate; pedicels resembling the rhachis, 30 mm. long at anthesis, ascending, separated by internodes 5–15 mm. long, subtended by a triangular-subulate bract 2 mm. long, and bearing 1–3 similar bracts scattered below the flower; petals oblong-elliptic, 12 mm. long, rounded at the apex and minutely apiculate, glabrous, minutely punctate; stamens very numerous, erect, flattened, 11 mm. long, the linear marginal pollen-sacs 10 mm. long; style lateral, linear, straight, erect, 9 mm. long; hypanthium broadly obconic, 3 mm. high; sepals broadly triangular, acute, erect, 1 mm. long.

Type, *Gleason 211*, collected in dense forest between Kangaruma and Potaro Landing, British Guiana, 25–27 June 1921, and deposited in the herbarium of the New York Botanical Garden.

The genus *Lecostemon* is one of the most poorly known members of a group of genera characteristic of the forests of northern South America, of which *Hirtella*, *Licania*, and *Parinarium* are much more abundant. Displaying but little superficial resemblance to these genera, it has even been placed in the Rutaceae, although its lateral style is an indication of its affinity with the Chrysobalineae. Our species is most closely related to *L. amazonicum* Spruce, in which the leaves are coriaceous and veiny, the rhachis distinctly tomentulose, and the flowers close together, on pedicels only 5 or 6 mm. long.

Vouapa Jenmani n. sp. Arborescent; twigs glabrous, roughened with lenticels, the internodes 1–2 cm. long; leaves evenly pinnate, 5–6-jugate; petioles 10–12 mm. long, rugose, glabrous, deeply furrowed above; rhachis prominently canaliculate, its sides sometimes spreading and the rhachis then subalate; leaflets 10–17 mm. apart, subsessile, oblong-lanceolate, acute, entire, inequilateral at base, the narrow side cuneate with the swollen, petiole-like midvein exposed for 2–3 mm., the broad side obtusely cuneate to subrotund, glabrous on both sides; 3–5 prominent veins leave the midvein at the basal extension of the broad side of the leaf, other veins from the midvein, arcuately curved near the margin into two intra-marginal veins, the veinlets finely reticulate; racemes axillary, eventually 75 mm. long; flowers crowded distally, the internodes elongating after anthesis; rhachis obtusely angled, thinly but softly brown-velutinous; pedicels 3 mm. long, velutinous; bracts pubescent, 8 mm. long and ovate in bud, becoming oblong and 10 mm. long during anthesis; sepals oblong-linear, glabrous, 4 mm. long; petal 12 mm. long, its blade broadly triangular-cuneate; filaments capillary, 30 mm. long; stipe of the ovary 2 mm. long, densely pubescent, the hairs continuing as a fringe along both margins of the ovary; style filiform.

Type, *Jenman 4076*, collected on the upper Demerara River, British Guiana, Sept. 1887, and deposited in the herbarium of the New York Botanical Garden (also in the Kew Herbarium). *La Cruz 2534* agrees with it precisely in foliar characters and bears a flat, obliquely elliptic pod 13 cm. long by 7.5 cm. wide, with the dorsal margin flat, 6 mm. wide, and prominently 2-edged.

Mabea ciliata n. sp. Arborescent, 5 m. high; stem minutely puberulent or glabrous; stipules triangular-subulate, 2–3 mm. long; petioles glabrous, 7 mm. long; leaf-blades thin and membranous when young, becoming firm in age, oblong, 85–115 mm. long, 30–43 mm. wide, abruptly acuminate into an oblong, subacute cusp 6–10 mm. long, entire or obscurely undulate, broadly rounded or subcordate at base, glabrous on both surfaces, minutely purple-ciliate; lateral veins about 9 pairs, arcuately connected toward the margin, the veinlets obscure and partially reticulate; rhachis of the inflorescence purple, minutely puberulent; bracts narrowly ovate, long-acuminate, reflexed, those of the pistillate flowers glandless; glands of the staminate clusters large, pale, adnate to the rhachis by one side; pistillate flowers solitary, on minutely puberulent pedicels 5 mm. long, the sepals ovate, long-acuminate, 1.6 mm. long; staminate flowers ternate in the axils of the bracts, the pedicels purple, minutely puberulent, jointed in the middle, 6–12 mm. long, the sepals broadly ovate, subacute; stamens about 30.

Type, *Gleason 831*, collected in dense upland forest, Rockstone, British Guiana, 15 July–1 Aug. 1921, and deposited in the herbarium of the New York Botanical Garden. *Mabea ciliata* is obviously a member of the section Apodae, having glandless sepals on the pistillate flowers and axillary staminate flowers without a common peduncle. The six species of the section heretofore described have no more than 12 stamens and differ also in various other characters.

Only two works are extant which treat the Hippocrateaceae of northern South America with any degree of completeness. Miers monographed the group in 1872, basing his work chiefly if not entirely on the material available to him in England, retaining the old genus *Hippocratea*, reviving five old genera, and erecting eleven new ones, retaining 66 previously described species, of which no less than 48 necessarily received new names, and describing 50 new species. Of his sixteen genera, five belong to *Hippocratea*, in the sense of Bentham and Hooker and the Pflanzenfamilien, and eleven to *Salacia*. Six years later Peyritsch monographed the Brazilian species in the Flora Brasiliensis, including several extra-limital ones. He rejected completely Miers' classification of the family, dividing the species between the two genera *Hippocratea* and *Salacia* according to the structure of the fruit. Peyritsch apparently did not examine the herbarium material at Kew or the British Museum, since twelve species described by Miers from Brazil, with cited

specimens, are neglected entirely. Since 1878, comparatively few additional species have been described from South America, notwithstanding the numerous explorations of the country, so that one may be justified in believing that the small size of the flowers on most species and the difficulty of matching flowering with fruiting material have led to most botanists neglecting the family.

Many will probably concur with Peyritsch that Miers' segregation of the family was entirely too minute. There may be some ground for separating *Kippistia* and two related groups as genera, since their styles are opposite to the stamens, rather than alternate with them, as in the rest of the family. There may also be reason for continuing the genus *Peritassa*, in which the stamens are relatively long and erect, with the connective prolonged far beyond the anther-sacs. It is also obvious that several of Miers' genera have striking habital characters, such as *Raddia*, *Tontelea*, and *Hylenaea*, but that alone is no justification for assigning them generic rank. The character of the fruit, often emphasized by Miers, is certainly more important, but fruiting material is so rare for most species that it forms by no means a satisfactory basis. On the other hand, the character of the disk, which assumes several different forms, is duplicated in *Hippocratea* and *Salacia*. Thus the disk of Miers' genus *Thermophylla*, usually merged with *Salacia*, is essentially the same as in *Hippocratea sensu angustiore*, and the low annular disk of *Prionostemma* and *Pristimera*, now considered as *Hippocratea*, is repeated in *Tontelea* and other sections of *Salacia*.

Miers' division of species is also more minute than that of Peyritsch, who found it advisable to unite no less than eight species recognized by Miers in *Hippocratea* into the single polymorphic *Hippocratea ovata* Lam. (*H. volubilis* L.), and he would probably have treated at least three others in the same fashion if they had come within the geographic range of his discussion.

Hippocratea lutea n. sp. Stems woody, apparently climbing; branches terete, glabrous, sparsely verrucose with small lenticels, the internodes 8–12 cm. long; leaves opposite; petioles glabrous, channeled above, 10–12 mm. long; blades thin but firm, yellowish green, broadly elliptic, 8–10 cm. long, 45–55 mm. wide, rounded at the apex and then prolonged into a narrowly triangular, acute, somewhat recurved cusp 10–12 mm. long by half as wide, entire,

broadly obtuse or rounded at base, strictly glabrous; lateral veins usually five pairs, ascending at an angle of 50–60° and paralleling the margin nearly to the apex, veinlets conspicuously reticulate, both veins and veinlets prominently elevated and equally conspicuous on both sides; rameal leaves limited to a single pair on the larger branches, elliptic-oblong, 7–9 cm. long by 30–35 mm. wide, broadly acute at base, acuminate at apex, otherwise like the cauline; inflorescences from all the upper axils, loosely and irregularly pseudo-trichotomous, 8–10 cm. long and wide, the lowest branches 2–10 mm. from the base, the lowest internodes 2–3 cm. long, the upper gradually reduced, the lower nodes bearing one terminal and two lateral axes, the upper a terminal flower and two lateral axes, and the uppermost 3 flowers; bractlets broadly triangular-ovate, 1 mm. long, minutely denticulate; pedicels 1–3 mm. long; sepals broadly rotund, obtuse, minutely denticulate, prominently many-veined, very irregular in size, the inner nearly 2 mm. long, becoming thin and scarious toward the margin, the outer shorter and thicker; petals 5, bright yellow, broadly elliptic, 6.5 mm. long by 4.5 mm. wide, strongly boat-shaped, prominently veined, narrowly involute at the entire margin; disk thin, membranous, saucer-shaped, glabrous, 0.6 mm. high; stamens 3; filaments flat, 1.5 mm. long by 0.5 mm. wide, somewhat recurved over the margin of the disk; anthers dorsifix, 0.8 mm. long and wide, decurved, transversely ringent; ovary prominently 3-lobed; style stout, terete, 0.6 mm. long; stigmas 3, barely spreading, opposite the stamens; fruit unknown.

Type: *Jenman 2149*, collected in British Guiana, 1886, and deposited in the herbarium of the New York Botanical Garden.

Hippocratea flava n. sp. Stems woody, apparently climbing; branches glabrous, terete, with a very few lenticels, the internodes 6–8 cm. long; leaves opposite; petioles glabrous, strongly channeled above, 10–12 mm. long; blades yellow-green, very thin when young, becoming firm with age, oblong-lanceolate to oblong-elliptic, long-acuminate to a sharp apex, entire, abruptly cuneate at base, 12–17 cm. long, 45–75 mm. wide, glabrous; lateral veins 6–7 pairs, curved-ascending at an angle of about 60° and arcuately connected near the margin, veinlets conspicuously reticulate, both veins and veinlets prominently elevated on both sides; inflorescences from all the upper axils, loosely and irregularly pseudo-trichotomous or subalternately branched, the basal peduncle 3–5 cm. long, bearing a terminal flower and two lateral branches, the upper internodes progressively shorter, the uppermost bearing 3 flowers; bractlets broadly triangular, scarious, acute, 1 mm. long; lowest pedicels 20–25 mm. long, jointed 5 mm. below the flower, the upper gradually shortened to 5 mm. but always jointed 2–5 mm. below

the flower; sepals broadly rotund, obtuse, essentially entire, irregular in size, the smallest 2.4 mm. long, the upper 3.5 mm. long, prominently veined and very thin and scarious at the margin; petals 5, bright yellow, broadly rotund-obovate, 7.5–8 mm. long and wide, strongly boat-shaped, prominently veined, glabrous, strictly entire; disk thin, membranous, saucer-shaped, irregularly annular, somewhat folded in 6 places, 2–2.5 mm. in diameter, 0.7 mm. high; stamens 3; filaments 1.5 mm. long, flat, much widened at base, narrowed above, arching over the margin of the disk; anthers conspicuously 2-lobed, decurved, transversely ringent, 1.0 mm. wide, 0.6 mm. long; ovary prominently 3-lobed; style stout, terete, 0.4 mm. long; stigmas 3, broadly oval, 0.5 mm. long, horizontally spreading, opposite the stamens; fruit unknown.

Type: *La Cruz 4134*, collected at Kamakusa, on the upper Mazaruni River, British Guiana, 11–22 July 1922, and deposited in the herbarium of the New York Botanical Garden. Duplicates have been distributed to the Gray Herbarium, the Philadelphia Academy of Sciences, and the National Herbarium. Other specimens are *Bond, Gillin, & Brown 59*, from the Orinoco Delta (also in the herbarium of the Philadelphia Academy of Sciences), and probably *Persaud 80*, a sterile specimen from Akyma, British Guiana (also in the herbarium of the Field Museum), referred here by leaf characters alone.

The differences between *Hippocratea lutea* and *H. flava* lie in the shape of the leaf, the character of the inflorescence, and the size of the flower. In the former the leaf is apiculate and broad, in the latter acuminate and narrow; in the former the many-flowered inflorescence branches from near the base and the flowers are on short pedicels, in the latter the basal peduncle is long, and the flowers relatively few and long-pedicelled; in *H. lutea* all parts of the flower are distinctly smaller than in *H. flava*.

Of greater importance are the similarities between the two and their common differences from other members of the family. The two agree notably in the general character of the foliage and inflorescence, in the sepals of irregular size, in the large, yellow, boat-shaped petals, in the structure of the disk and stamens, and above all in the peculiar character of stigmas opposite the stamens.

Miers was apparently the first to discover that such a character existed in the family. On that basis he separated three

genera, *Kippistia*, *Cheiloclinium*, and *Anthozoma*, represented by eight species in Brazil and the Amazonian region. All of these have an unlobed ovary, and are also distinguished by various peculiarities of the disk, stamens, and stigmas, not one of which is found in our two species. Miers' genera were united with *Salacia* by Peyritsch, while our two, with their strongly 3-lobed ovaries, are almost certainly members of *Hippocratea*. Turning now to the detailed descriptions of floral structure in the segregates of that genus, as presented and illustrated by Miers, we find no mention of opposite stigmas, while his drawings and discussion lead us to believe that he would scarcely have overlooked such a structure had it been present. Four of his five segregates differ from our two species in various characters of the flower or inflorescence, but in *Pristimera* we find the same pale green, reticulately veined foliage, the same long-pedicelled flowers, the same disk and stamens, the same 3-lobed ovary, and the same prominent stigmas. In fact, the resemblance extends so far that *Jenman 2149* was identified originally as *Pristimera apiculata*. On the other hand, Miers does not mention any irregularity in the size of the sepals or the conspicuously boat-shaped petals, while emphasizing in his drawings, his description, and the derivation of his generic name the pectinate margins of both sepals and petals, while the petals of our plants are strictly entire and the sepals almost so.

Paullinia rufescens Rich. seems to be a common species in British Guiana. Its stems and foliage are regularly rufescent; the large leaflets are rounded or broadly cuneate at base, finely but not very conspicuously reticulate, with curved lateral veins, and thickly pubescent beneath. The fruit has been figured by Radlkofer both in his monograph of the genus and in the Flora Brasiliensis. Recent collections from British Guiana show that a closely related species also occurs which is as yet undescribed.

Paullinia Hitchcockii n. sp. Stem nearly terete, very finely puberulent, rufescent; leaf-rhachis angled or channeled, puberulent; leaflets 5, their blades subcoriaceous, somewhat shining above, obovate, the lower 35–50 mm. wide, 65–100 mm. long, the uppermost 55–75 mm. wide, 110–150 mm. long, all abruptly acuminate into an oblong blunt cusp nearly 1 cm. long, conspicuously sinuate-dentate along the distal half, long-cuneate (terminal leaflet) to short-cuneate or obtuse (lateral leaflets) at base, glabrous above or minutely puberulent on the midvein, sparsely pubescent beneath; lateral veins about 8 pairs, almost

straight, the veinlets elevated on both sides and conspicuously reticulate; flowers lacking; spikes 5–12 cm. long, single in the axils; fruit red-brown, ellipsoid, 12 mm. long, 7 mm. in diameter, tri-alate above the middle, the surface and the wings conspicuously veiny.

Type, *Hitchcock 17,129*, collected at the Penal Settlement, British Guiana, 3–9 Dec. 1919, and deposited in the herbarium of the New York Botanical Garden. Here are referred also *La Cruz 1617*, near Wismar, *La Cruz 1725*, Dadanawa, and *La Cruz 3916*, Wanama River, Northwest District.

P. Hitchcockii may be distinguished at a glance from *P. rufescens* by its leaf characters, especially the obovate leaflets, the conspicuous terminal cusp, the prominent dentation, and the cuneate bases. The pubescence is of the same morphological character, but in *P. Hitchcockii* the hairs of the lower surface average 0.03–0.05 mm. long and stand 0.10–0.15 mm. apart, while in *P. rufescens* they are 0.05–0.10 mm. long and stand only 0.03–0.05 mm. apart. The fruit-wings of the latter species are decurrent nearly or quite to the base, while in *P. Hitchcockii* the basal portion of the fruit is quite wingless.

Paullinia arenicola n. sp. A vine 4 m. long; the finely striate stem minutely puberulent; leaf-rhachis prominently angled or channeled, minutely puberulent; leaflets 5, subcoriaceous, dull green or somewhat shining, narrowly oblong-elliptic or oblong-lanceolate, 8–10 cm. long, 30–38 mm. wide, broadest at or below the middle and gradually tapering to a blunt apex, conspicuously dentate throughout with blunt, salient, somewhat callous teeth mostly 8–15 mm. apart and 2–3 mm. long, cuneate to obtuse at base, glabrous on both surfaces; lateral veins about 8 pairs, ascending at an angle of 45°, the veinlets prominently elevated and conspicuously reticulate on both sides; spikes solitary, axillary, 5–10 cm. long, closely puberulent; stipe of the fruit 5 mm. long; fruit-body ellipsoid, 12 mm. long, 7 mm. in diameter, tri-alate above the middle, the wings decurrent to the base, body and wings red-brown, prominently veined.

Type, *Gleason 803*, collected on dry sand hills, east of Rockstone, British Guiana, 22–30 July 1921, and deposited in the herbarium of the New York Botanical Garden. A second collection is *Gleason 818*, from the same locality. The measurements are taken from the type; in the second collection the leaves are smaller and somewhat shining on the upper surface. *P. arenicola* is also related to *P. rufescens*, and differs in its small, glabrous, strongly dentate, and conspicuously reticulate leaves.

Cupania obovata n. sp. Leaf-rhachis closely and finely ferruginous-puberulent, terete below, flattened and strongly angled above; leaflets about 7, thin and membranous, obovate-oblong, broadly rounded or somewhat retuse at the apex, entire or slightly undulate, cuneate to a petiolule about 5 mm. long, minutely puberulent along the midvein on both sides, otherwise glabrous, the lower 30–38 by 50–65 mm., the uppermost 45 by 110 mm.; lateral veins 6–8 pairs, curved-ascending, impressed above with obscure veinlets, the venation elevated and conspicuously reticulate beneath; panicles freely branched, 20–30 cm. long, the branches prominently channeled, minutely puberulent below, becoming tomentulose above; pedicels 1 mm. long; sepals broadly obovate-oblong, 1.7 mm. long, 1–1.3 mm. wide, closely tomentose; petals 5, apparently white, broadly obovate, 1.3 mm. long, 1 mm. wide, thinly white-villous, especially on the basal half; scales 2, semi-obovate, 0.8 mm. long, attached to the side and base of the petal, densely white villous with hairs 0.6 mm. long; stamens 8, intradiscal, about equal; filaments erect, stout, 0.9 mm. long, densely villous on the basal two-thirds; ovary about equaling the filaments; disk fleshy, annular, continuous.

Type, *La Cruz 4379*, collected at Kamakusa, on the upper Mazaruni River, British Guiana, 11–22 July 1923, and deposited in the herbarium of the New York Botanical Garden. The obovate rounded leaflets give the plant the aspect of a *Matayba;* although fruit is unfortunately lacking, the character of the scales on the petals indicates that it is a *Cupania.*

Lysiostyles pubescens n. sp. Climbing woody vine, the young twigs closely and finely pubescent with reddish hairs, the older stems glabrous and exfoliating thin layers of bark; petioles 10–15 mm. long, pubescent like the stem; leaf-blades firm or subcoriaceous, elliptic-oblong, 10–14 cm. long, 5–8 cm. wide, rounded toward the apex into a very short, triangular, obtuse point, entire, rounded or subcordate at base, glabrous above, closely subtomentose beneath with brown hairs; veins obscure above, elevated and prominently reticulate beneath; inflorescences numerous, axillary, 3–8 cm. long, pubescent like the stem, consisting of a rhachis bearing 5–10, 3–5-flowered cymes on peduncles 2–3 mm. long; bractlets minute; pedicels 1–2 mm. long; calyx densely pubescent, 2 mm. long, two outer lobes broadly ovate, subacute, three inner lobes depressed rotund, broader than wide, obtuse; corolla-tube glabrous, 1.5 mm. long; corolla-lobes somewhat spreading, triangular-lanceolate, 3 mm. long, acute, densely brown-pubescent without, terminated by a filiform appendage 1.5–2 mm. long; filaments glabrous, 1 mm. long, slightly tapering upwards; anthers 0.8 mm. long, the anther-

sacs about two-thirds as long as the stout connective; ovary spherical, densely hirsute with erect hairs; styles separate to the base, glabrous, 0.8 mm. long; stigmas capitate, spherical, 0.2 mm. in diameter.

Type, *Persaud 67*, collected at Wismar, British Guiana, July 1924, and deposited in the herbarium of the New York Botanical Garden. *Lysiostyles pubescens* differs from *L. scandens* Benth., the only species of the genus hitherto known, chiefly in the shape of the leaf at base and apex, in the glabrous upper leaf surface, in the acute outer sepals, and in the completely hirsute ovary.

TRICHANTHERA GIGANTEA (H. & B.) Nees. This acanthaceous tree, originally described from Colombia, seems to have a wide distribution across northern South America. It has been recently collected in the department of Bolivar by Pennell, *4101;* in El Valle by Pennell and Killip, *6193;* in Portuguesa, Venezuela, by Pittier, *12,056*, and in the Northwest District of British Guiana by La Cruz, *1348*. A still older specimen in the Kew herbarium, *Jenman 371*, extends the range to the eastern boundary of British Guiana. These lowland forms have larger flowers, more hirsute filaments, smaller and more loosely branched inflorescences, and somewhat glaucous leaves, with the veins not elevated on the upper side, and may be distinguished as the variety **guianensis.**

Miconia Toroi n. sp. Section Amblyarrhena: Stems strongly obtusely 4-angled, the internodes 2–4 cm. long, glabrous, the nodes densely hirsute with brownish hairs 3–5 mm. long; petioles 8–15 mm. long, densely hirsute like the nodes; leaf-blades membranous, dull green, oblong-elliptic, as much as 175 mm. long by 75 mm. broad, sharply acuminate, minutely dentate and ciliate, cuneate at base, 3-nerved with a faint additional marginal pair, the secondaries strongly ascending and somewhat reversely arcuate; upper surface thinly hirsute with straight brown hairs 1–1.8 mm. long; lower surface similarly hirsute along the secondaries and veinlets and densely hirsute with hairs 1–2 mm. long on the primaries; inflorescence 13 cm. long, the sessile 5-merous flowers glomerate or subsecund at the end of short lateral branches, the axes and branches finely pubescent in two opposite lines; bractlets minute, obovate, conspicuously ciliate; hypanthium urceolate, glabrous, 1.8 mm. long to the torus; calyx strongly thickened distally into a fleshy ring, with 5 spreading or somewhat reflexed exterior teeth and 5 broadly triangular sepals each 0.1 mm. long; petals obovate-oblong, retuse, glabrous, 2.8 mm. long, 1.6 mm. wide,

pinkish; stamens isomorphic, all turned in the same direction at anthesis; filaments slender, 1.7–1.8 mm. long; anthers stout, bright purple, slightly retuse, 1.25 or 1.5 mm. long, opening by a minute terminal pore, the connective neither appendaged nor prolonged; ovary about one-third free, its glabrous summit strongly ribbed; style straight, terete, 2.2 mm. long, slightly tapering distally; stigma capitate.

Type, *Toro 278*, collected at Angelopolis, near Medellín, Colombia, 27 July 1927, and deposited in the herbarium of the New York Botanical Garden. The relation of *M. Toroi* to the group including the familiar *M. ciliata* and *M. racemosa* is immediately obvious. It most nearly resembles *M. pulvinata* Gleason, from which it is distinguished by the fleshier calyx, the densely hirsute nodes, the longer and more hirsute petioles, and the pubescent leaves.

Blepharodon ornatum n. sp. Stems twining, slender, glabrous, with a ring of subulate reflexed appendages 1 mm. long at the nodes; petioles slender, glabrous, 3–6 mm. long; leaf-blades firm, elliptic or oblong, 30–45 mm. long, 12–18 mm. wide, acute or subacuminate and aristate at apex, entire, cuneate to an acute base, glabrous, the upper surface almost veinless, the lower paler green and obscurely veined; leaf-base with 2 or 3 subulate reflexed appendages 1–2 mm. long; peduncles slender, glabrous, about 1 cm. long, with a whorl of subulate bracts about 1 mm. long above the middle and another at the summit; pedicels about 3, umbellate, 15–25 mm. long; sepals spreading or reflexed, ovate, 2.5 mm. long, the center finely reticulate, the margins scarious; corolla rotate; petals ovate-triangular, 8 mm. long, connate for one-third of their length, reticulately veined, pubescent on the upper side near the margin; lobes of the corona 4 mm. long, adnate to the stamens for half their length, the basal portion laterally compressed and somewhat ventricose, outer lobe flaring, ovate, obtuse, inner lobe erect, acuminate; stamens tipped with a semi-circular hyaline appendage arching over the 5-tuberculate stigma.

Type, *Gleason 805*, collected on dry sandhills, east of Rockstone, British Guiana, July 1921, and deposited in the herbarium of the New York Botanical Garden. It is distinguished from *B. Steudelianum* (Miq.) Pulle by the shape of the corona, the longer, bracted peduncles, the few-flowered inflorescence, and the subulate appendages at the nodes and the base of the leaves.

Extraordinary sexual phenomena in plants[1]

JOHN H. SCHAFFNER

The usual phenomena of sexuality may be classified under a few definite terms as: primary and secondary sexual states and characters; specific attraction and fusion of gametes (fertilization); specific attraction, pairing, and segregation of diploid chromosome complements (reduction division); diploid and haploid conditions; the influence of secondary sexual states in producing sexual dimorphisms; the time of sex-determination and sex-reversal; and the distribution of sexual states in the individual as represented by unisexual and hermaphroditic individuals and monosporangiate (diecious) and bisporangiate individuals of various types and degrees. All of these conditions are involved in the usual expressions of sexuality in the course of the ontogenetic and phylogenetic developments. There are also various abnormal peculiarities which are widespread in both the plant and animal kingdoms which must have a prominent place in any comprehensive study of sexuality; among which may be mentioned: self and cross sterility; specific compatibilities and incompatibilities; and the several types of parthenogenetic developments in which cells, after male or female sexualization, return either to a secondary sexual state or to a neutral vegetative condition, new individuals being produced without a union with a cell of the opposite sexual state.

In the plant kingdom a number of extraordinary conditions have evolved which tend to throw considerable light on the problem of the nature of sex, and it is the purpose of this paper to catalog some of the more common and well-known cases, in order that they may be brought into the general discussion of the subject which at present has such a prominent place in biological thought.

When we think of sexuality as + (female) and − (male) conditions we are apt to attribute definite differential qualities to the two conditions, and such may really exist, but, on the other hand, the differences may be only due to degrees of in-

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tensity of development of a common condition. In *Spirogyra* and other conjugates, as shown by various investigators, three types of special reproductive cells may be produced—aplanospores, zygospores, and parthenospores. Both the plus and minus cells may produce parthenospores. In organisms with more highly differentiated gametes the female cell alone retains the capacity for parthenogenetic development. This is probably because of its much lower metabolism as indicated by its lower catalase activity, its food-storing ability, etc. In the higher Spirogyras, the entire filament is normally determined as male or female at the time of conjugation, but as various workers have shown, and as is easily observed in certain species, the cells of a filament may react as + (female) toward one filament and as − (male) toward another. This becomes apparent when a filament is parallel with another filament for only a part of its length and comes to be parallel with a third filament for the remaining part. This suggests that possibly in some stages of development, at least, male and female are but relative terms and + and − only different levels or degrees of the same fundamental condition. Various cases have also been reported where each of two conjugating filaments reacts in one part as female and in another as male toward the other. All such phenomena are decidedly illuminating when it is remembered that these filaments are haploids and have originated from a reduction spore.

The Oedogoniaceae present several remarkable conditions in the evolution of their sexuality. Only one phase of the subject will be considered here. In both *Oedogonium* and *Bulbochaete*, certain species produce so-called dwarf males. Among the species which produce filaments with oospheres and androspores, and dwarf males from the androspores, may be mentioned *Oe. Borisianum* (Le Cl.) Wittr., *Oe. nebraskense* Ohashi, and *Oe. Wolleanum* Wittr. The haploid individual coming from the reduction spore, instead of producing oospheres and spermatozoids, like a normal hermaphroditic *Oedogonium*, produces, as stated above, oospheres and androspores. The androspores must be regarded as derived phylogenetically from original spermatozoids. The egg cell or oosphere is usually situated above a sister cell which is usually called a suffultory cell. This cell apparently has some female qualities. The

androspores show a partial primary sexual state and are attracted to the oogonium or to the suffultory cell. In the species mentioned they usually settle down on the suffultory cell. In some species of *Oedogonium* and *Bulbochaete* they mostly settle upon the oogonium itself. Thus these androspores plainly show a partial primary sexual state. They react toward and are attracted by the suffultory cell or the oogonium, but at this point the ordinary primary properties disappear or cease to act, and through parthenogenetic development a dwarf male filament is produced as an epiphyte, which finally furnishes the functional spermatozoids and these not only have attractive properties but also the power of fusing with the female gamete. The dwarf male, of course, shows decided secondary sexual dimorphism, not only because its cells are in the secondary male state, but also because it originated parthenogenetically from a cell which had developed at least a partial primary male state, which has a decided effect on its functional activity at the very beginning. The Oedogoniaceae are probably the highest plants in which parthenogenetic male development is possible. In plants higher in the scale, the spermatozoid is apparently too extremely differentiated morphologically and physiologically to be able to germinate; so parthenogensis is known only in the female gamete.

In the Oedogoniaceae then, we have a series of unusual sexual phenomena, all coming from a single haploid spore, the whole series of sexual changes and peculiarities, both normal and abnormal, being produced without a change of chromosome complement. Recently Goldschmidt and others have attempted to develop a theory of sexuality based on the idea of a balance of genes. Anyone can see that a 'balance of genes' is not involved in the matter, since the same genes and the same chromosome complement is maintained from beginning to end. The original haploid filament exhibits a neutral state, secondary female and primary female states, partial primary male state and perhaps a partial primary female state in the suffultory cell, while the dwarf male with the same hereditary complex, with the original complement of chromosomes, shows only a secondary male state and a primary male state. The same 'balance of genes' has produced practically every kind of sex reaction known. The change from one reaction to another is not caused by a

change in the balance of genes. It will also be noted that when the cells are in a neutral vegetative state a very different filament is produced from that produced when the cells are in the secondary male state. If a filament could be developed with the secondary female state it would probably show a trimorphism with the other two.

The higher fungi, including both ascomycetous and basidiomycetous groups, have developed a very unusual and remarkable sexual condition. These plants must be regarded as having evolved from the condition of a simple haploid sexual cycle. In this condition the gametes fuse to form the zygote and at the germination of the zygote reduction takes place, giving rise to haploid spores from which the haploid individual is developed, as in the Conjugatae, the simpler *Oedogonia*, and most of the other green algae. In these higher fungi a haploid mycelium is the normal initial stage with uninucleate cells. When sexual reproduction begins, two cells become sexualized as + and − and conjugate directly, as shown by various investigators, a pore being developed between the fused cell walls and the minus determined protoplast passes over into the plus determined cell. However, no fusion of the nuclei takes place. The pair of haploid nuclei must, however, retain some degree of a primary sexual state, since they can so influence each other that they normally divide simultaneously and each new cell apparently receives a pair of daughter nuclei. Thus a mycelium is developed with binucleate cells. In the Ascomycetae this conjugate phase is usually not extensive, but in the Basidiomycetae and Teliosporae an extensive binucleate mycelium may be developed. In the rusts, as in *Puccinia graminis* Pers., the binucleate phase at first produces aeciospores, which may be regarded as simply a special kind of conidia. These aeciospores each have a pair of nuclei and propagate the rust on the wheat plant, developing a conjugate phase or generation. In all Ascomycetae, Teliosporae, and Basidiomycetae, apparently, a cell is finally produced—the initial ascus cell, teliospore, or basidium—in which the pair of nuclei develop the complete primary sexual states and immediately fuse, giving rise to a normal diploid zygote. This zygote nucleus, on dividing, undergoes the reduction division, as is usual in plants with a simple, haploid, sexual cycle, and the resulting ascospores or basidiospores are haploid again with a single nucleus.

In the Basidiomycetae, the binucleate phase has certain interesting complications, in the development of clamp connections, which seem to have some relation to a + and − condition of the conjugate nuclei.

In this case, the sexualization of the cells, which should end in perfect gametes with primary sexual states, apparently stops short of the complete process, and only partial primary sexual states are developed. The sexualization, however, goes one step further than is the case in the androspores of *Oedogonoium* and *Bulbochaete*, so that there is not only an attractive property and reaction toward the opposite sexual state, but an actual penetration of the one protoplast into the other. The ability to fuse is either absent or is neutralized in the presence of the opposite sexual state.

In certain Basidiomycetae various workers have apparently found a number of compatible and incompatible strains within the species, which seem to be involved in the sexual interactions of certain heterothallic mycelia. If there are numerous strains in some of these species of Agarics, as we know them in various species of rusts and smuts, it may be possible that a careful study of them would throw some light on the relation of hereditary strains to sexual compatibility and incompatibility. The whole group needs careful study in this respect, not only of the phenomena themselves, but especially from the standpoint of correct interpretation, which at present seems to be following the fantastic lines developed in connection with sexual phenomena in the higher plants and animals. Apparently sex-reversal is an easily induced process in many of the heterothallic species, since under artificial culture the heterothallic or unisexual mycelia pass over spontaneously to the homothallic or hermaphroditic condition after a time, as found by several investigators, more especially by Vandendries in *Coprinus radians* (Desm.) Fr., and by Miss Newton in *Coprinus Rostrupianus* Hansen.

The conjugate condition is then to be regarded as an intercalated phase, brought about, in the phylogeny of the group, by a mutative change which interfered with the complete primary sexualization, for the time being, of the gametes. But by a parthenogenetic vegetative growth a binucleate phase or generation was produced which shows a succession of evolutionary advances in the various ascomycetous and basidiomycetous

groups. With the complete primary sexualization of the paired nuclei the conjugate phase disappears in the formation of the diploid cell or zygote.

Thus we must recognize three general types of sexual states—the secondary sexual state, the partial primary sexual state, and the complete primary sexual state. The partial primary sexual state shows two recognizable phases or conditions; first, primary sexualization to the extent that only attraction toward the opposite state is shown but no fusion whatever, as in the androspores of *Oedogonium* and *Bulbachaete;* second, primary sexualization to the extent that not only attractive properties are present to such a degree that cytoplasmic fusion is accomplished, but also association of the + and − nuclei, without nuclear fusion, however. Such partial sexual states may perhaps also arise in the sexualization of the synaptic chromosomes and become a prolific source of chromosome disturbances and hereditary irregularities.

When a cell is in the secondary sexual state, its hereditary expression and activity are influenced so that sexual dimorphisms are produced. When a cell is in the partial primary sexual state, attractive properties of various degrees are developed, but these do not lead to the fusion of the sexual nuclei, and in the lowest condition not even to cytoplasmic fusion. When a cell is in the complete primary sexual state, there is not only attraction and reaction toward the opposite sexual state, but, if nothing interferes, complete fusion of the two nuclei is accomplished. The fusion of the nuclei brings about a neutral condition, or a secondary male or female state may follow. In some cases in the higher plants at least, as will be shown below, fusion of nuclei may be followed by a further primary sexualization immediately. In all homosporous plants and in all heterosporous species except the diecious ones, fusion of the gametes ends definitely in a neutral vegetative state, the so-called nonsexual sporophyte. The three types or phases of sexualization are developed both as male or as female conditions and have no direct bearing on the differential involved in comparing these conditions with each other as + and − manifestations of unknown physical phenomena.

Sex reversal has been found to be rather common in the unisexual gametophytes of certain homosporous plants and also

in the monecious and diecious species of the heterosporous groups. But the sexual condition and differentiation of the gametophytes of heterosporous plants seems to be very extremely fixed. The sexual state handed over to them from the sporophyte seems to become so extreme and the sexual dimorphism so great that we ordinarily think no sex reversal in such an individual could be possible, and this is probably true so far as the male gametophyte is concerned. But there are certain cases in the gymnosperms, and a very general phenomenon in the angiosperms, which clearly show that cells from the female gametophyte may develop + and − relations and react toward each other as female and male, in other words develop complete primary female and male states, which condition brings about fusion of the two types of nuclei.

In the gymnosperms, the archegonium develops an egg and a ventral canal cell. The nuclei are sisters. Usually the ventral canal cell disorganizes promptly. There are sporadic cases, however, in which the ventral canal nucleus does not degenerate but fuses with the egg nucleus. Such fusions have been observed in several genera, especially in *Pinus* and *Picea*. The ventral canal cell in its degenerative process must arrive at a neutral condition and if the degenerative process is arrested it may pass over to the − or male state and fusion with the + egg nucleus is the inevitable result. Here then we have a case in which a cell of a highly differentiated female gametophyte, a sister cell of the egg itself, has its sexual state reversed to a primary male state. It must not be forgotten that these cells come from a haploid individual, so that there has been no reduction of chromosomes and no shifting of hereditary potentialities. The change from reproductive female cell to the male condition, is, of course, well known in animals, as in chickens and pigeons. In the animal, however, the change takes place in a diploid individual.

The angiosperms have what may be regarded as the most remarkable phenomena in the plant kingdom in the processes of triple and multiple fusions. There is apparently nothing corresponding to these conditions in any other plant or animal group.

In certain gymnosperms, as reported by Miss Herzfeld for *Ephedra campylopoda* Meyer, one of the two male nuclei fuses

with the ventral canal nucleus while the other fuses with the egg nucleus. This simply indicates that in the given case the sister nuclei had both passed from the secondary female state to the primary female state, which condition should be expected occasionally, since the joint-firs represent a group with a much shortened gametophytic ontogeny, and during the phylogenetic history the differentiation process, through which primary sexualization is brought about, has been thrown back continuously into an earlier stage because of an abbreviation of the cell lineage. In so far as these abnormalities involve the primary sexualization of normally secondary sexual cells, they correspond to the condition of triple fusion in the embryo-sac of the angiosperms.

In the usual type of triple fusion, as developed in the Anthophyta, the two so-called polar nuclei of the female gametophyte fuse with each other and with the second sperm from the pollen tube about the same time that fertilization is accomplished through the fusion of the egg nucleus and the first sperm. It must be remembered that the upper polar nucleus is a sister nucleus of the egg nucleus and the lower polar nucleus is a sister of the upper of the three antipodals which according to Porsch's view probably also represents a degenerate egg phylogenetically. Every possible order in the fusion of the three nuclei has been observed, so that the triple fusion is brought about in a variety of ways. Often the polar nuclei have already fused when the pollen-tube enters the embryo-sac and the sperm nucleus unites with the fusion nucleus. This condition has been reported for various Ranunculaceae, *Tricyrtis*, *Datura*, *Silphium*, etc. In other cases the polar nuclei and the second sperm may all be attracted and all fuse together at the same time. In some cases the male nucleus may come in contact with either of the polar nuclei while they are still separate; in some cases the male nucleus fuses with the upper polar first and the lower is then attracted to and fuses with this diploid nucleus; in still other cases the sperm is attracted to the lower polar first. These differences in the order of fusions are explainable on the hypothesis that the polar nuclei are not always sexualized at the same time, so that either the upper or the lower nucleus may attain primary sexual maturity before the other. In either case the polar nucleus will have a + reaction toward the extremely male sperm nucleus. Now all the cells of the embryo sac are originally

in the secondary female state which was handed over from the megaspore and thus always show an enormous secondary sexual dimorphism when compared with those of the male gametophyte. But in case the two polars fuse together first, they have the + and − reaction toward each other. In probably most cases the lower one has developed the minus or male reaction. In *Alisma* and *Sagittaria*, which the writer studied intensively, the lower polar nucleus was always the smaller. In *Sagittaria latifolia* Willd. the upper polar nucleus is by far the largest nucleus in the embryo sac, considerably larger than even the nucleus of the egg. Thus it is evident that the difference in size of the two polars is not entirely due to their positions in the upper and lower ends of the sac but, to a certain extent at least, to some differential condition or state which is influencing their development. This difference in sexual development or reaction of two cells of the female gametophyte may be comparable to the opposite, reactions which take place in a sexually differentiated *Spirogyra* filament, as presented above, where part of the filament may react as + toward one filament and the other part as − toward another filament. We can then properly speak of a reversal in the one or the other polar nucleus from the female state to the male state.

There has been much speculation as to whether this triple fusion should be regarded as a fertilization, since no sporophyte embryo results from it, but a xeniophyte. There is no essential difference in the attraction and fusion of the nuclei in this case from a normal fertilization. There is a mixture of chromosomes which subsequently act as a unity in the formation of nuclei by indirect nuclear division. That an entirely different course of differentiation takes place is due to neither the heredity involved nor to the number of chromosomes. We know that a sporophyte may result from a haploid or triploid nucleus as well as from a diploid one. The difference in the subsequent hereditary expression is due to the positions and functional states of the cells involved.

Now if triple fusion were the only unusual sexual event in the Anthophyta, we might rest content with our simpler ideas of what is involved in the sexualization of a cell. The most remarkable conditions, however, are the multiple fusions of cells of the embryo sacs of such genera as *Peperomia*, *Gunnera*,

etc. In *Peperomia* by an added cell division stage, a 16-celled female gametophyte is produced. These 16-celled sacs must be regarded as secondary conditions derived from a normal eight-celled sac, as Johnson has maintained, and the multiple fusions occurring in them as secondary developments from an original triple fusion. Probably the most extreme case is that which Johnson found in *Peperomia hispidula* Dietr. where 14 of the nuclei of the 16-celled embryo sac fuse together to produce the primary endosperm nucleus. There was no evidence of a fusion with the second sperm from the pollen tube. In *Peperomia pellucida* Kunth eight nuclei fuse to form the definitive nucleus. These remarkable nuclear fusions involve primary sexualization with the + and − interactions although other properties may be involved. In various plants, like *Fucus*, the egg attracts many sperms, but the fusion is nevertheless with a single one.

Among the lower plants, there are several classes which show mutual attractions between cells which do not appear to involve the ordinary + and − reactions of sexualized cells. The attraction of the cells to form a plasmodium in the Myxomycetae, the gregarious association of the cells in the pseudoplasmodium of the Myxobacteriales, and the symmetrical associations of cells resulting in the colonies of *Pediastrum* and *Hydrodictyon* are probably due to special physical states or conditions not directly related to sexualization, or if sexualization is involved we must assume for the time being that other, quite distinct states and properties are present at the same time. With our present imperfect knowledge of the nature of such states and properties it will be most expedient to regard such associations as appear in *Hydrodictyon*, etc. as of a different physical order from primary sexual states, although it must be admitted that there are some similarities in the reactions. In the multiple fusions of nuclei in the abnormal embryo sacs additional states and properties may also be developed, as intimated above, beside the usual + and − or male and female primary sexualization. The wonder is that a workable and working nucleus comes out, and it is not surprising that in *Peperomia hispidula* Dietr. the primary endosperm nucleus gives rise to only about 40 endosperm cells.

Whatever hypotheses or explanations of the sexual states

and conditions may be attempted, the remarkable sexual phenomena recounted above must be taken into account as well as the conditions which we assume to be normal, otherwise they will be of little or no value in the scientific attempt to solve the mysteries of sexuality. It seems foolish to the writer to attempt theories until we have at least made a study of the phenomena that may possibly have a fundamental bearing on the problem we are attempting to solve. It must also be evident to any one acquainted with even only the ordinary phenomena of sexuality, that the recent genetic speculations which have been put forth with such seemingly great confidence have very little to do with the matter, and their main effect seems to be to teach young biologists certain dogmas that make even the simplest and easiest experimentation on sex control and sex reversal seem impossible.

COLUMBUS, OHIO

INDEX TO AMERICAN BOTANICAL LITERATURE

1925–1927

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Adams, J. A short guide to Canadian genera of seed plants. Canada Dept. Agr. Bull. n. s. 78: 1–97. 1927.

Asami, Y. On the self-sterility of the Japanese pear. Proc. Am. Soc. Hort. Sci. **23**: 122–127. "1926" 1927.

Baldwin, I. L., Fred, E. B., & Hastings, E. G. Grouping of legumes according to biological reactions of their seed proteins. Bot. Gaz. **83**: 217–243. *f. 1, 2.* 25 My 1927.

Barrel, G. H. Walnut in Amazonas. Tropical Woods 10: 51–53. 1 Je 1927.

Bartlett, H. H. Sumatran plants collected in Asahan and Karoland with notes on their vernacular names. Papers Michigan Acad. Sci. **6**: 1–66. Mr 1927.

Baxter, D. V. Some Porias from the region of the Lake states. Papers Michigan Acad. Sci. **6**: 67–76. *pl. 1–6.* Mr 1927.

Beals, A. T. Dr. George N. Best, 1846–1926. Bryologist **30**: 20–22. *port.* "Mr" 15 Jl 1927.

Beckett, R. E. Growth of fruiting parts in *Gossypium cernuum*, an Asiatic cotton. Jour. Agr. Res. **35**: 97–106. *f. 1–4.* 15 Jl 1927.

Belling, J. The attachments of chromosomes at the reduction division in flowering plants. Jour. Genetics **18**: 177–204. *f. 1–16.* Je 1927.

Belling, J. Configurations of bivalents of *Hyacinthus* with regard to segmental interchange. Biol. Bull. **52**: 480–487. *f. 1–5.* Je 1927.

Belling, J. The nomenclature of chromosome groups. Nature **119**: 926. 25 Je 1927.

Bennett, C. W. Virus diseases of raspberries. Michigan Agr. Exp. Sta. Tech. Bull. 80: 1–38. *pl. 1–9.* My 1927.

Benoist, R. Sur le bois de quelques Anonacées americaines. Bull. Soc. Bot. France **74**: 281–285. Mr–Ap 1927.

Berg, A. Tomato late blight and its relation to late blight of potato. West Virginia Agr. Exp. Sta. Bull. 205: 1–31. *f. 1–7.* Jl 1926.

Blanchard, F. C. Heterogametic and homogametic hybrids between two mutations of *Oenothera pratincola*. Papers Michigan Acad. Sci. **6**: 133–180. Mr 1927.

Blanchard, F. C., & Bartlett, H. H. The inheritance of red bud color in crosses of *Oenothera pratincola* and related forms. Papers Michigan Acad. Sci. **6**: 77–132. Mr 1927.

Blinks, L. R. On *Valonia* and *Halicystis* in eastern America. Science II. **65**: 429–430. 29 Ap 1927.

Bowman, H. H. M., & Yee, M. A. The nutritive value of the mung bean. Papers Michigan Acad. Sci. **6**: 181–188. *pl. 7.* Mr 1927.

Phaseolus aureus.

Boynton, K. R. Tulips. Jour. N. Y. Bot Gard. **28**: 143–148. *f. 6.* Je 1927.

Abstract of a lecture.

Brink, R. A. Genetics and the problems of development. Am. Nat. **61**: 280–283. My–Je 1927.

Brink, R. A. Studies on pollen tube development in a partially sterile hybrid between *Linaria vulgaris* and *L. purpurea*. Zeitsch. Induk. Abstamm. Vererb. **44**: 129–148. *f. 1.* 1927.

Britton, N. L. Further botanical studies in Porto Rico. Jour. N. Y. Bot. Gard. **28**: 125–131. *f. 1, 2.* Je 1927.

Bush, B. F. The glabrate species of *Tilia*. Bull. Torrey Club **54**: 231–248. "Mr" 2 My 1927.

Bush, B. F. Some species of *Viburnum*. Am. Midl. Nat. **10**: 225–243. Mr–My 1927.

Caldis, P. C. Etiology and transmission of endosepsis (internal rot) of the fruit of the fig. Hilgardia **2**: 287–328. *pl. 1–16*. Ja 1927.

Caldis, P. C., & Coons, G. H. Achromatic variations in pathogenic fungi. Papers Michigan Acad. Sci. **6**: 189–236. *pl. 8–18*. Mr 1927.

Canby, M. L. The genus *Corethrogyne* in southern California. Bull. So. California Acad. Sci. **26**: 8–16. Ja–Ap 1927.

Carter, W. A technic for use with homopterous vectors of plant disease, with special reference to the sugar-beet leaf hopper, *Eutettix tenellus* Baker. Jour. Agr. Res. **34**: 449–451. *f. 1*. 1 Mr 1927.

Chang, C. Y. Origin and development of tissues in rhizome of *Pteris aquilina*. Bot. Gaz. **83**: 288–306. *f. 1–18*. 25 My 1927.

Coker, W. C. New or noteworthy Basidiomycetes. Jour. Elisha Mitchell Sci. Soc. **42**: 251–257. *pl. 47–49*. My 1927.

In *Clavaria, Lachnocladium, Geaster,* and *Arachnion.*

Coker, W. C. Other water molds from the soil. Jour. Elisha Mitchell Sci. Soc. **42**: 207. *pl. 27–36*. My 1927.

Genus *Calyptralegnia,* and several species described as new.

Coker, W. C., & Patterson, P. M. A new species of *Pythium*. Jour. Elisha Mitchell Sci. Soc. **42**: 247–250. *pl. 46*. My 1927.

P. torulosum.

Colby, A. S. Notes on self-fertility of some gooseberry varieties. Proc. Am. Soc. Hort. Sci. **23**: 138–140. "1926" 1927.

Colley, R. H., Hartley, C., & Taylor, M. W. A morphologic and biometric comparison of *Cronartium ribicola* and *Cronartium occidentale* in the aecial stage. Jour. Agr. Res. **34**: 511–532. *f. 1–5*. 15 Mr 1927.

Collins, G. N. Yield and the number of seminal roots in maize. Jour. Am. Soc. Agron. **19**: 466–467. My 1927.

Conner, A. B., & Karper, R. E. Hybrid vigor in sorghum. Texas Agr. Exp. Sta. Bull. 359: 1–23. *f. 1–6.* My 1927.

Cook, O. F. Barley in Egypt before wheat. Jour. Hered. **18**: 175–176. "Ap" 7 Je 1927.

Cook, O. F. New genera and species of ivory palms from Colombia, Ecuador and Peru. Jour. Washington Acad. Sci. **17**: 218–230. 4 My 1927.
In *Phytelephas* and *Ammandra*.

Coons, G. H., & Stewart, D. Prevention of seedling diseases of sugar beets. Phytopathology **17**: 259–296. *f. 1–9.* 15 My 1927.

Cooper, N. David Douglas. Gard. Chron. III. **80**: 250–251. 25 S 1926.

Couch, J. N. Some new water fungi from the soil, with observations on spore formation. Jour. Elisha Mitchell. Sci. Soc. **42**: 227–242. *pl. 37–43.* My 1927.

Coulter, J. M. Revision of the genus *Myrrhidendron*. Jour. Washington Acad. Sci. **17**: 213–215. 4 My 1927.
2 species described as new.

Crandall, C. S. Apple breeding at the University of Illinois. Illinois Agr. Exp. Sta. Bull. 275: 341–599. *f. 1–113.* Je 1926.

Culpepper, C. W., & Magoon, C. A. A study of the factors determining quality in sweet corn. Jour. Agr. Res. **34**: 413–434. *f. 1–6.* 1 Mr 1927.

Darrow, G. M. Sterility and fertility in the strawberry. Jour. Agr. Res. **34**: 393–411. *f. 1–14.* 1 Mr 1927.

Davidson, A. Botanical field notes. Bull. So. California Acad. Sci. **26**: 16. Ja–Ap 1927.

Detjen, L. R. A preliminary report on cabbage breeding. Proc. Am. Soc. Hort. Sci. **23**: 325–332. "1926" 1927.

Dickey, S. S. Cow-poison. Nat. Mag. **9**: 384. *illust.* Je 1927.
Veratrum viride.

Dobbie, H. B. Finding a new fern. Am. Fern. Jour. **17**: 64–66. 18 Je 1927.
Lomaria capensis.

Doby, G., & Hibbard, R. P. Nutrient ions of plants and the ion activation of plant enzymes. Jour. Biol. Chem. **73**: 405–416. *f. 1–3.* Je 1927.

Duff, G. H., & Welch, C. G. Sulphur, as a control agent for common scab of potato. Phytopathology **17**: 297–314. *f. 1.* 15 My 1927.

Durland, W. D. The pine forests of Honduras. Tropical Woods 10: 8–9. 1 Je 1927.

Edgerton, C. W., & Tims, E. C. Investigations on the sugar cane disease situation in 1925 and 1926. Louisiana Agr. Exp. Sta. Bull. 197: 1–50. *f. 1–11.* Ap 1927.

Ellsworth, H. A. Inheritance of carpel displacement. Jour. Hered. **18**: 133. *f. 19.* "Mr" 13 My 1927.

Epling, C. C. Studies on South American Labiatae. III. Synopsis of the genus *Satureia*. Ann. Missouri Bot. Gard. **14**: 47–86. 8 Je 1927.

Evans, M. W. The life history of timothy. U. S. Dept. Agr. Bull. 1450: 1–56. *f. 1–6 + pl. 1–12.* Mr 1927.

Ezell, B. D., & Crist, J. W. Effect of certain nutrient conditions on activity of oxidase and catalase. Michigan Agr. Exp. Sta. Tech. Bull. 78: 1–24. *f. 1–3.* My 1927.

Fernald, M. L. Some varieties of *Artemisia borealis*. Rhodora **29**: 93–95. "My" 6 Je 1927.

Fernald, M. L. *Streptopus oreopolus* in the White Mountains. Rhodora **29**: 76. "Ap" 2 My 1927.
Mt. Washington.

Fisher, R. T. A museum of forest antiquity. Am. For. & For. Life **33**: 348. *illust.* Je 1927.
So-called Pigsah forest in southern New Hampshire.

Fromme, F. D., Wingard, S. A., & Priode, C. N. Ringspot of tobacco: an infectious disease of unknown cause. Phytopathology **17**: 321–328. *f. 1–6.* 15 My 1927.

Fryxell, F. M. The green tree. Am. For. & For. Life **33**: 357–360. *illust.* Je 1927.

LeClaire elm in Iowa.

Gardner, N. L. New Rhodophyceae from the Pacific coast of North America. III. Univ. California Publ. Bot. **13**: 333–368. *pl. 59–71.* 12 My 1927.

Gardner, N. L. A new species of *Entophysalis* from China, and notes on other species of the genus. Univ. California Publ. Bot. **13**: 369–372. *pl. 72.* 12 My 1927.

Garrett, A. O. Spring flora of the Wasatch region. 4th ed. rev. i–iv, 1–208. Salt Lake City, Stevens and Wallis, 1927.

Gaylord, I. N. California cañon ferns. Am. Fern Jour. **17**: 61–63. 18 Je 1927.

Girton, R. E. The growth of citrus seedlings as influenced by environmental factors. Univ. California Publ. Agr. Sci. **5**: 83–117. *f. 1–8.* 15 Ap 1927.

Gleason, H. A., & Cook, M. T. Plant ecology of Porto Rico. Sci. Survey Porto Rico and the Virgin Islands **7**[1–2]: 1–173. *pl. 1–50.* 22, 25 F 1927.

Gluck, H. A new *Sagittaria* from Florida: *Sagittaria Kurziana*. Bull. Torrey Club **54**: 257–261. "Mr" 2 My 1927.

Goldstein, B. The x-bodies in the cells of dahlia plants affected with mosaic disease and dwarf. Bull. Torrey Club **54**: 285–294. *f. 1, 2 + pl. 18–20.* "Ap" 16 My 1927.

Graham, V. O. Ecology of fungi in the Chicago region. Bot. Gaz. **83**: 267–287. *f. 1–6.* 25 My 1927.

Grier, N. M., & Green, S. A. A phaenological note on the flora of the vicinity of Cold Spring Harbor, N. Y. Ohio Jour. Sci. **27**: 138–142. 31 My 1927.

Gundersen, A. Families of vascular plants (except dicotyledons). Brooklyn Bot. Gard. Leaflet **15**[4]: 1–4. 11 My 1927.

Gustafson, F. G. Plant distribution as affected by the hydrogen-ion concentration of the soil. Papers Michigan Acad. Sci. **6**: 237–246. Mr 1927.

Haas, A. R. C. Relation between fruit size and abscission of young orange fruits. Bot. Gaz. **83**: 307–313. 25 My 1927.

Harms, H. Araliaceae americanae novae. I. Repert. Spec. Nov. Reg. Veg. **23**: 299–301. 20 Mr 1927.

Harris, G. H. The activity of apple and filbert roots especially during the winter months. Proc. Am. Soc. Hort. Sci. **23**: 414–422. *f. 1–6.* "1926" 1927.

Harter, L. L., & Whitney, W. A. Relation of soil temperature and soil moisture to the infection of sweet potatoes by the stem-rot organism. Jour. Agr. Res. **34**: 435–442. *f. 1, 2.* 1 Mr 1927.

Harter, L. L., & Whitney, W. A. A transit disease of snap beans caused by *Pythium aphanidermatum*. Jour. Agr. Res. **34**: 443–448. *pl. 1.* 1 Mr 1927.

Harvey, J. V. *Brevilegnia diclina* n. sp. Jour. Elisha Mitchell Sci. Soc. **42**: 243–246. *pl. 44, 45.* My 1927.

Hein, I. Studies on morphogenesis and development of the ascocarp of *Sphaerotheca Castagnei*. Bull. Torrey Club **54**: 383–417. *f. 1–5 + pl. 28, 29.* "My" 18 Je 1927.

Helwig, B. Convolvulaceae austro-americanae novae. Notizbl. Bot. Gart. Berlin **9**: 1136–1138. 25 Mr. 1927.
Several species in *Jacquemontia* described as new.

Henrard, J. T. *Eragrostis triangularis* spec. nov. aus Paraguay. Repert. Spec. Nov. Reg. Veg. **23**: 301–302. 20 Mr 1927.

Hepburn, J. S., Jones, F. M., & St. John, E. Q. Biochemical studies of the North American Sarraceniaceae. Trans. Wagner Free Inst. Sci. Phila. **11**: 1–95. *illust.* Ap 1927.

Heppner, M. J. Study of Bartlett pear black-end undertaken in California. Science II. **65**: 280–281. 18 Mr 1927.

Hildreth, A. C. Determination of hardiness in apple varieties and the relation of some factors to cold resistance. Minnesota Agr. Exp. Sta. Tech. Bull. 42: 1–37. *f. 1–5.* Je 1926.

Himmel, W. J. A contribution to the biophysics of *Podophyllum* petioles. Bull. Torrey Club **54**: 419–451. *f. 1–5 + pl. 30, 31.* "My" 18 Je 1927.

Hitchcock, A. E., & Zimmerman, P. W. Variation in rooting response of cuttings placed in media in different pH value. Proc. Am. Soc. Hort. Sci. **23**: 383–390. *pl. 1, 2.* "1926" 1927.

Hitchcock, A. S. The grasses of Ecuador, Peru, and Bolivia. Contr. U. S. Natl. Herb. **24**: i–xx, 291–556. 1927.

29 species described as new.

Hitchcock, A. S. How the taxonomists may utilize the international committee on nomenclature. Science II. **65**: 412–414. 29 Ap 1927.

Hitchcock, A. S. Two new grasses from South America. Jour. Washington Acad. Sci. **17**: 215–217. *f. 1, 2.* 4 My 1927.

Olyra sampaiana and *Trisetum bulbosum.*

Hofmann, F. N. Reciprocal effects from grafting. Jour. Agr. Res. **34**: 673–676. 1 Ap 1927.

Howlett, F. S. Methods of procedure in pollination studies. Proc. Am. Soc. Hort. Sci. **23**: 107–119. "1926" 1927.

Hurst, C. C. The conception of a species. Science II. **65**: 271–273. 18 Mr 1927.

Jansson, K. P. Rayless *Aster multiflorus.* Rhodora **29**: 95. "My" 6 Je 1927.

Jeffrey, E. C. New light on evolution. Science II. **65**: 458–462. 13 My 1927.

Jenkins, A. E. Brown canker of the rose. Am. Rose Annual **1927**: 161–183. *pl. 11–19.* 1927.

Jodidi, S. L. Isolation and identification of some organic compounds occurring in etiolated corn seedlings. Jour. Agr. Res. **34**: 649–656. 1 Ap 1927.

Johnson, J. The classification of plant viruses. Wisconsin Agr. Exp. Sta. Res. Bull. 76: 1–16. *f. 1–8.* F 1927.

Jones, H. A. Pollination and life history studies of lettuce (*Lactuca sativa* L.). Hilgardia **2**: 425–478. *pl. 1–18.* Ap 1927.

Jones, H. A., & Robbins, W. W. Influence of desiccation and root pruning on performance of *Asparagus*. Proc. Am. Soc. Hort. Sci. **23**: 26–28. "1926" 1927.

Kanehira, R. Note on the identity of the Chinese "pau-hoi." Tropical Woods 10: 53–54. 1 Je 1927.

Karling, J. S. Variations in the mature antheridium of the Characeae: a descriptive study in morphogenesis. Bull. Torrey Club **54**: 187–230. *f. 1–13* + *pl. 10–14.* "Mr" 2 My 1927.

Keen, B. A. Some physical and physico-chemical effects of soil organic matter. Jour. Am. Soc. Agron. **19**: 362–368. My 1927.

Keim, F. D., & Beadle, G. W. Relation of time of seeding to root development and winter survival of fall seeded grasses and legumes. Ecology **8**: 251–264. *f. 1–6.* Ap 1927.

Kelley, A. P., & Shoemaker, M. B. Staining of yeast cells. Bot. Gaz. **83**: 318. 25 My 1927.

Kenoyer, L. A. Notes on Indian ruderals. Papers Michigan Acad. Sci. **6**: 247–251. Mr 1927.

Kirby, R. S. Diseases of small grains. Cornell Agr. Exp. Sta. Ext. Bull. 157: 1–71. *f. 1–31.* Mr 1927.

Klugh, A. B., & Martin, J. R. The growth-rate of certain marine algae in relation to depth of submergence. Ecology **8**: 221–231. *f. 1–4.* Ap 1927.

Knott, J. E. Further localization of the response in plant tissue to relative length of day and night. Proc. Am. Soc. Hort. Sci. **23**: 67–70. "1926" 1927.

Knuth, R. Oxalidacearum species novae americanae. II. Repert. Spec. Nov. Reg. Veg. **23**: 275–282. 20 Mr 1927.

Korstian, C. F., & Stickel, P. W. The natural replacement of blight-killed chestnut in the hardwood forests of the northeast. Jour. Agr. Res. **34**: 631–648. *f. 1–9.* 1 Ap 1927.

Kulkarni, C. G. Inheritance studies of white-capping in Yellow Dent maize. Papers Michigan Acad. Sci. **6**: 253–273. Mr 1927.

Larsen, E. L. A revision of the genus *Townsendia*. Ann. Missouri Bot. Gard. **14**: 1–46. *pl. 1–7*. 8 Je 1927.

Lee, H. A., & Martin, J. P. A method for testing in vitro the toxicity of dust fungicides to fungous spores. Phytopathology **17**: 315–319. 15 My 1927.

Leissner, G. Nilsson-. Relation of selfed strains of corn to F_1 crosses between them. Jour. Am. Soc. Agron. **19**: 440–454. My 1927.

Leonard, E. C. Fourteen new species of plants from Hispaniola. Jour. Washington Acad. Sci. **17**: 65–73. *illust.* 3 F 1927.

Lewis, W. F. Some Adirondack rarities. Am. Fern Jour. **17**: 37–43. 18 Je 1927.

Lloyd, F. E. Cell disjunction in *Spirogyra*. Papers Michigan Acad. Sci. **6**: 275–287. *f.* 1 + *pl. 19*. Mr 1927.

Lyon, H. L. Exotic trees in Hawaii (cont.) Hawaiian Pl. Rec. **31**: 163–169. *illusl.* Ap 1927.

Lyon, M. W., Jr. List of flowering plants and ferns in the Dunes State Park and vicinity, Porter County, Indiana. Am. Midl. Nat. **10**: 245–295. Mr–Ap 1927.

Mackenzie, K. K. *Solidago altissima* L. Rhodora **29**: 72–75. "Ap" 2 My 1927.

Mangelsdorf, A. J. Origin of the garden strawberry. Jour. Hered. **18**: 177–183. *f. 18–21*. "Ap" 7 Je 1927.

Martin, J. H., & Ratliffe, G. T. Loose kernel smut on feterita. Phytopathology **17**: 338–339. 15 My 1927.

Matzke, E. B. An analysis of the orthic tetrakaidecahedron. Bull. Torrey Club **54**: 341–348. *f. 1–6*. "Ap" 16 My 1927.

Melchior, H. Plantae Steinbachianae. II. Notizbl. Bot. Gart. Berlin **9**: 1155–1160. 25 Mr 1927.

Merrill, E. D. *Swinglea*, a new generic name in the Rutaceae. Jour. Arnold Arbor. **8**: 131–132. Ap 1927.

Mildbraed, J. Plantae Tessmannianae peruvianae. IV. Notizbl. Bot. Gart. Berlin **9**: 1139–1154. *f. 18.* 25 Mr 1927.

Genera *Tessmannianthus* and *Meiandra*, as well as many species, described as new.

Mockeridge, F. A. The auximone theory. Bot. Gaz. **83**: 314–317. 25 My 1927.

Moore, H. C. Hollow heart in potatoes. Papers Michigan Acad. Sci. **6**: 289–294. Mr 1927.

Morris, L. S., & Crist, J. W. The influence of reaction of culture medium on growth of strawberry plants. Michigan Agr. Exp. Sta. Tech. Bull. 77: 1–16. *f. 1–6.* My 1927.

Mottier, D. M. Behavior of certain fern prothallia under prolonged cultivation. Bot. Gaz. **83**: 244–266. *f. 1–7 + pl. 10.* 25 My 1927.

Munz, P. A. The southern California species of *Salvia* (including *Ramona*). Bull. So. California Acad. Sci. **26**: 17–29. *pl. 3, 4.* Ja–Ap 1927.

Murray, C. D. A relationship between circumference and weight in trees and its bearing on branching angles. Jour. Gen. Physiol. **10**: 725–729. *f. 1, 2.* 20 My 1927.

Nelson, A. Taxonomic studies. 1. The loco plants. 2. Miscellaneous new species. Univ. Wyoming Publ. Sci. **1**: 109–143. *f. 7.* 15 Mr 1926.

In *Chenopodium, Allium, Zygadenus, Delphinium, Phlox, Pentstemon, Machaeranthera, Antennaria, Gaillardia, Lessingia, Actinea* and *Senecio.*

Oskamp, J. Soil moisture and tree growth relationships. Proc. Am. Soc. Hort. Sci. **23**: 269–277. "1926" 1927.

Ostenfeld, C. H. The flora of Greenland—its origin. K. Danske Vidensk. Sels. Biol. Meddel. **6**[2]: 1–71. *f. 1–3.* 22 N 1926.

Overholser, E. L. Apple pollination studies in California. California Agr. Exp. Sta. Bull. 426: 1–17. My 1927.

Owen, F. V. Hereditary and environmental factors that produce mottling in soy beans. Jour. Agr. Res. **34**: 559–588. *f. 1–4 + pl. 1.* 15 Mr 1927.

Parodi, L. R., & Thellung, A. *Alopecurus bonariensis* Parodi et Thell. spec. nov. Repert. Spec. Nov. Reg. Veg. **23**: 302–303. 20 Mr 1927.

Payson, E. B. *Thlaspi*, *Oreocarya*, and *Erigeron*. Univ. Wyoming Publ. Sci. **1**: 145–186. *f. 8–16.* 15 Mr 1926.

1. The genus *Thlaspi* in North America. 2. *Oreocarya*. 3. *Erigeron compositus* and its allies in the United States.

Peattie, D. C. *Trillium* in North and South Carolina. Jour. Elisha Mitchell Sci. Soc. **42**: 193–206. My 1927.

Philp, G. L. Some pollination difficulties in cherry production. Proc. Am. Soc. Hort. Sci. **23**: 28–30. "1926" 1927.

Pickett, F. L., & Thayer, L. A. The gametophytic development of certain ferns: *Polypodium vulgare* var. *occidentale* and *Pellaea densa*. Bull. Torrey Club **54**: 249–255. *pl. 15–17.* "Mr" 2 My 1927.

Pittier, H. The Lecythidaceae of Central America. Contr. U. S. Nat. Herb. **26**: 1–14. *pl. 1–12.* 1927.

11 species described as new.

Quisenberry, K. S. Correlated inheritance of quantitative and qualitative characters in oats. West Virginia Agr. Exp. Sta. Bull. 202: 1–55. *f. 1–4.* Jl 1926.

Record, S. J. The editor again visits Central America. Tropical Woods 10: 1–3. 1 Je 1927.

Record, S. J. Trees of Hunduras. Tropical Woods 10: 10–47. 1 Je 1927.

Reed, G. M., Swabey, M., & Kolk, L. A. Experimental studies on head smut of corn and sorghum. Bull. Torrey Club **54**: 295–310. *pl. 21–25.* "Ap" 16 My 1927.

Rehder, A. Charles Sprague Sargent. Jour. Arnold Arbor. **8**: 69–86. *port.* Ap 1927.

Born 24 Ap 1841. Died 22 Mr 1927.

Ricker, P. L. Give the wild flowers a chance. Nat. Mag. **9**: 303–306. *6 col. pl.* My 1927.

Ripperton, J. C. Carbohydrate metabolism and its relation to growth in the edible canna. Hawaii Agr. Exp. Sta. Bull. 56: 1–35. *f. 1–17.* My 1927.

Robbins, W. W., & Jones, H. A. Sex as a factor in growing asparagus. Proc. Am. Soc. Hort. Sci. **23:** 19–23. *f. 1.* "1926" 1927.

Roberts, J. W., & Dunegan, J. C. Peach brown rot and scab. U. S. Dept. Agr. Farmers Bull. 1527: 1–14. *f. 1–6.* Ap 1927.

Rosa, J. T. Direct effects of pollen on fruit and seeds of melons. Proc. Am. Soc. Hort. Sci. **23:** 243–249. "1926" 1927.

Rose, J. N. Professor D. Carlos Spegazzini 1858–1926. Jour. N. Y. Bot. Gard. **28:** 118–119. My 1927.

Rusby, H. H. Additions to the genus *Munnozia* R. and P. Bull. Torrey Club **54:** 311–320. "Ap" 16 My 1927.

Rydberg, P. A. Notes on Fabaceae—IX. Bull. Torrey Club **54:** 321–336. "Ap" 16 My 1927.

Several species in *Hamosa*, described as new.

Salter, F. J. The chemical composition of soil organic matter as related to its effectiveness. Jour. Am. Soc. Agron. **19:** 397–409. My 1927.

Sandwith, N. Y. New species from the Andes of Argentina. Kew Bull. Misc. Inf. **1927:** 174–188. *pl. 1.* 1927.

In *Berberis, Malvastrum, Cristaria, Larrea, Anarthrophyllum, Adesmia, Cassia, Chuquiragua, Calceolaria, Argylia,* and *Verbena.*

Sarton, G. Introduction to the history of science. vol. 1. From Homer to Omar Khayyam. Carnegie Inst. Washington Publ. 376: 1–839. 1927.

Schaffner, J. H. Additions to the catalog of Ohio vascular plants for 1926. Ohio Jour. Sci. **27:** 95–101. 29 Ap 1927.

Schaffner, J. H. Sex-limited characters and allosome-linked heredity. Ohio Jour. Sci. **27:** 105–126. 31 My 1927.

Schaffner, J. H. Spiral shoots of *Equisetum.* Am. Fern Jour. **17:** 43–46. *pl. 2.* 18 Je 1927.

Schmidt, O. C. Beiträge zur Kenntnis der Aristolochiaceen. I. Repert. Spec. Nov. Reg. Veg. **23**: 282–299. 20 Mr 1927.

Shamel, A. D., Pomeroy, C. S., & Caryl, R. E. Bud selection in the Washington navel orange. Jour. Hered. **18**: 135–142. *f. 20–22.* "Mr" 13 My 1927.

Shantz, H. L. Drought resistance and soil moisture. Ecology **8**: 145–157. Ap 1927.

Shuhart, D. V. The morphological differentiation of the pistillate flowers of the pecan. Jour. Agr. Res. **34**: 687–696. *f. 1–5 + pl. 1–6.* 1 Ap 1927.

Sigler, D., & Woollett, M. L. An ecological study of Hogback Bog, Cheboygan County, Michigan. Papers Michigan Acad. Sci. **6**: 295–302. *f. 1 + pl. 20.* Mr 1927.

Small, J. K. The palmetto-palm—*Sabal texana*. Jour. N. Y. Bot. Gard. **28**: 132–143. *f. 3–5.* Je 1927.

Biographical notes by John Hendley Barnhart.

Standley, P. C. The flora of Barro Colorado Island Panama. Smithsonian Inst. Misc. Coll. **78**: 1–32. 20 My 1927.

Standley, P. C. New or otherwise interesting trees and shrubs collected in Guatemala and Honduras in 1927 by Samuel J. Record and Henry Kuylen. Trop. Woods 10: 4–7. 1 Je 1927.

In *Coccoloba, Ruprechtia, Abutilon, Grislea, Tococa, Diospyrros* and *Rondeletia.*

Standley, P. C. New trees collected in Panama by George P. Cooper and George M. Slater. Trop. Woods 10: 47–51. 1 Je 1927.

In *Carapa, Meliosma, Cilharexylum, Cyphomandra.*

Stanford, E. E. *Polygonum hydropiper* in Europe and North America. Rhodora **29**: 77–87. "My" 6 Je 1927.

Steward, A. N. The *Hepatica transsilvanica* group of eastern Europe and Asia. Rhodora **29**: 53–54. "Ap" 2 My 1927.

Swartwout, H. G. Blister and black rot cankers. Mis Agr. Exp. Sta. Bull. 248: 1–15. *f. 1–13.* Mr 1927.

Swingle, C. F. Burrknot formations in relation to the vascular system of the apple stem. Jour. Agr. Res. **34**: 533–544. *f. 1–4* + *pl. 1–5*. 15 Mr 1927.

Swingle, C. F. A quantitative study of the effects of transplanting and of budding upon the growth of apple seedlings. Proc. Am. Soc. Hort. Sci. **23**: 99–104. "1926" 1927.

Taylor, N. Age and area. Ecology **8**: 283–284. Ap 1927.

Taylor, W. P. Ecology or bio-ecology. Ecology **8**: 280–281. Ap 1927.

Tharp, B. C. *Commelinantia Pringlei*. Bull. Torrey Club **54**: 337–340. *pl. 26, 27*. "Ap" 16 My 1927.

Thomas, W. The nitrogenous metabolism of *Pyrus malus*. Proc. Am. Soc. Hort. Sci. **23**: 73–80. *f. 1*. "1926" 1927.

Tiedjens, V. A. Some observations on root and crown bud formation in *Asparagus officinalis*. Proc. Am. Soc. Hort. Sci. **23**: 189–196. "1926" 1927.

Tiedjens, V. A. Some observations on the response of greenhouse cucumbers (*Cucumis sativa*) to certain environmental conditions. Proc. Am. Soc. Hort. Sci. **23**: 184–189. "1926" 1927.

Tiffany, L. H. The algal collection of a single fish. Papers Michigan Acad. Sci. **6**: 303–306. Mr 1927.

Todd, J. B. The finding of *Woodsia obtusa*. Am. Fern Jour. **17**: 57–59. 18 Je 1927.

Traub, H. P. The regional and seasonal distribution of moisture and food in 2–3 years apple twigs. Proc. Am. Soc. Hort. Sci. **23**: 127–131. *f. 1, 2*. "1926" 1927.

Trelease, W. *Agave* novae hispaniolenses. Repert. Spec. Nov. Reg. Veg. **23**: 362–363. 20 Mr 1927.

Trelease, W. Piperaceae hispaniolenses. Repert. Spec. Nov. Reg. Veg. **23**: 303–333. 20 Mr 1927.

Trelease, W. The Piperaceae of Panama. Contr. U. S. Nat. Herb. **26**: i–viii, 15–50. 1927.

Tucker, C. M. Pigeon pea anthracnose. Jour. Agr. Res. **34**: 589–596. *f. 1–3.* 15 Mr 1927.

Victorin, Marie- (Frère). Les Filicinées du Québec. Revue Triméstrielle Canad. Suppl. **9**: 1–98. Mr 1923.
(Contr. Lab. Bot. Univ. Montréal 2.)

Victorin, Marie- (Frère). Les Lycopodinées du Québec. Contr. Lab. Bot. Univ. Montréal 3: 1–121. *f. 1–11 + pl. 1.* 21 My 1925.

Victorin, Marie- (Frère). Études floristiques sur la région du lac Saint-Jean. Contr. Lab. Bot. Univ. Montréal 4: 1–74. *f. 1–28.* 1925.

Victorin, Marie- (Frère). Random botanical notes. L'Islet County, Quebec. Ottawa Naturalist 32: 109–111. 1918.

Victorin, Marie- (Frère). Note sur une florule halophytique-côtière reliquale dans le bassin du lac Saint-Jean. Proc. Trans. Roy. Soc. Canada III. **19**[1]: 97–108. 1925.

Victorin, Marie- (Frère). Sur quelques Composées nouvelles, rares ou critiques du Québec oriental. Proc. Trans. Roy. Soc. Canada III. **19**[1]: 79–96. *f. 1–3 + pl. 1–4.* 1925.
Cirsium minganense, and several varieties, described as new.

Victorin, Marie- (Frère). Notes sur quelques cas de teratologie végétale. Proc. Trans. Roy. Soc. Canada III. **20**[5]: 427–433. *f. 1, 2 + pl. 1.* 1926.

Victorin, Marie- (Frère). Notes pour servir à l'histoire de nos connaissances sur les Abiétacées du Québec. Proc. Trans. Roy. Soc. Canada III. **20**[5]: 437–460. *f. 1 + pl. 1–3.* 1926.

Victorin, Marie- (Frère). Nouvelles études sur les Composées du Québec. Proc. Trans. Roy. Soc. Canada III. **20**[5]: 461–482. *f. 1–3 + pl. 1–4.* 1926.
Several varieties and hybrids described as new.

Walpole, B. A. Distribution of the Cruciferae in Michigan. Papers Michigan Acad. Sci. **6**: 307–349. Mr 1927.

Waterman, W. G. Ecology of Glen Lake and Sleeping Bear region. Papers Michigan Acad. Sci. **6**: 351–376. *f. 1 + pl. 21–32.* Mr 1927.

Waters, C. E. A suburban fern bed. Am. Fern Jour. **17:** 52–57. Je 1927.

Webber, H. J. Rootstock reactions as indicating the degree of congeniality. Proc. Am. Soc. Hort. Sci. **23:** 30–36. *f. 1.* "1926" 1927.

Wehmeyer, L. E. Cultural life-histories of *Diaporthe.* I. Papers Michigan Acad. Sci. **6:** 377–396. *pl. 33–36.* Mr 1927.

Weimer, J. L. A wilt disease of alfalfa caused by *Fusarium* species. Phytopathology **17:** 337–338. 15 My 1927.

Weir, J. R. Butt rot in *Diospyros virginiana* caused by *Polyporus Spraguei.* Phytopathology **17:** 339–340. 15 My 1927.

Wester, P. J. Introduction of Manila hemp. Jour. Hered. **18:** 117–118. *f. 9–11.* "Mr" 13 My 1927.

Wherry, E. T. Divergent soil reactions of related plants. Ecology **8:** 197–206. Ap 1927.

Wherry, E. T. A fernless area. Am. Fern Jour. **17:** 63–64. 18 Je 1927.
Brownsville, Texas.

White, C. T. A previously undescribed species of *Maniltoa* from Papua. Jour. Arnold Arbor. **8:** 130. Ap 1927.
M. lenticellata.

Wiggans, C. B. A suggestion of a safer method for determining the relative value of cross and self-pollination in the apple. Proc. Am. Soc. Hort. Sci. **23:** 297–298. *f. 1.* "1926" 1927.

Wingard, S. A. The immediate effect of cross-pollination on the size and shape of bean seed. Genetics **12:** 115–124. *f. 1–3.* "Mr" 10 Je 1927.

Winkler, A. J. Some factors influencing the rooting of vine cuttings. Hilgardia **2:** 329–349. *f. 1–11.* Ja 1927.

Wister, J. C. The Iris; a treatise on the history, development and culture of the Iris. 1–122. *illust.* N. Y., Orange Judd Co., 1927.

Wolfe, T. K. A study of germination, maturity and yield in corn. I. The relation of kernel characters and environmental factors to the germination of corn. II. The relation between kernel characters and the maturity and yield of the corn plants produced from particular kinds of kernels. Virginia Agr. Exp. Sta. Tech. Bull. 30: 1–35. *f. 1.* Ja 1927.

Woodcock, E. F. Morphological studies of the seed of *Alsine media*. Papers Michigan Acad. Sci. **6**: 397–403. *pl. 37–38.* Mr 1927.

Woodworth, R. H. Interesting plants of northern Labrador. Rhodora **29**: 54–57. "Ap" 2 My 1927.

Wright, A. H., & Wright, A. A. The dwarf bearded Iris. I. A preliminary working list. Cornell Agr. Exp. Sta. 1–12. 4 F 1927.

York, H. H., Snell, W. H., & Rathbun-Gravatt, A. The results of inoculating *Pinus strobus* with the sporidia of *Cronartium ribicola*. Jour. Agr. Res. **34**: 497–510. *f. 1–3 + pl. 1.* 15 Mr 1927.

Zeller, S. M. A canker of apple and pear trees caused by *Glutinium macrosporium* n. sp. Jour. Agr. Res. **34**: 489–496. *f. 1–10.* 1 Mr 1927.

Zeller, S. M. Preliminary studies on witches' broom of strawberry. Phytopathloogy **17**: 329–335. *f. 1–4.* 15 My 1927.

Zerbee, F. B. A miniature greenhouse. Nat. Mag. **9**: 377–378. *illust.* Je 1927.

A Wardian case.